Space Weather Technical Forecast

Issued on Saturday, 07 May 2022 at 13:07 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight Chance of R1/R2 radio blackouts.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Low with GOES16 experiencing several C-class flares. There are currently three numbered sunspot regions on the visible disc. AR3004 classified as Dhi/beta-gamma with a C4 flare at 06/1622 UTC. AR3006 (Cai/beta) is relatively unchanged with minor activity observed in the leading spots. AR3001 remains a Hsx/alpha. Numerous filaments remain on the visible disc. No Earth-directed Coronal Mass Ejections (CMEs) were observed in available satellite imagery.

Solar Wind / Geomagnetic Activity: The solar wind was slow-ambient and ACE spacecraft showed a regime between 300-400 km/s. The solar wind density was similarly unremarkable in low single-figures ppcc, while the IMF was steady at or below 5nT, with a north-south component of +3/-5nT. The phi angle remained steadfastly negative (towards the Sun). The resulting geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours. The high energy electron flux has varied between Moderate and High levels, reaching a peak of 1354 pfu at 06/1620 UTC. Electron fluence was at a fairly steady level and at 07/0001 UTC the reading was 6.12e7pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a slight chance of M-class flares, mainly from the largest region AR3004, however activity will remain predominantly Low. M-class flares are probably most likely for the first couple of days and this might become less likely for days 3 and 4 (9th and 10th May) as AR3004 rotates across the western limb. However a new and potentially active region appears likely to rotate onto the southeast limb during this period to maintain a risk of Moderate activity.

Solar Wind / Geomagnetic Activity: No significant coronal holes feature in this forecast. Reanalysis of a centre-disc disturbance from the vicinity of AR3004 at 1700UTC on 03 May has resulted in a low confidence CME with an Earth-bound component. The CME might arrive later on day 1 (7 May), but is more likely early on day 2 (8 May). There is a slight Chance of Minor Storm/G1 (Kp 5) from this event, otherwise geomagnetism should remain predominantly Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is at Background levels, and is expected to continue at this level through the period. There is a daily Slight Chance of S1 largely as a result of AR3004's westward advance. The high energy electron flux (greater than 2MeV) is forecast to remain at predominantly Moderate levels, but could reach the High threshold (1000 pfu) at the peak of its diurnal oscillation on day 1 (7 May).

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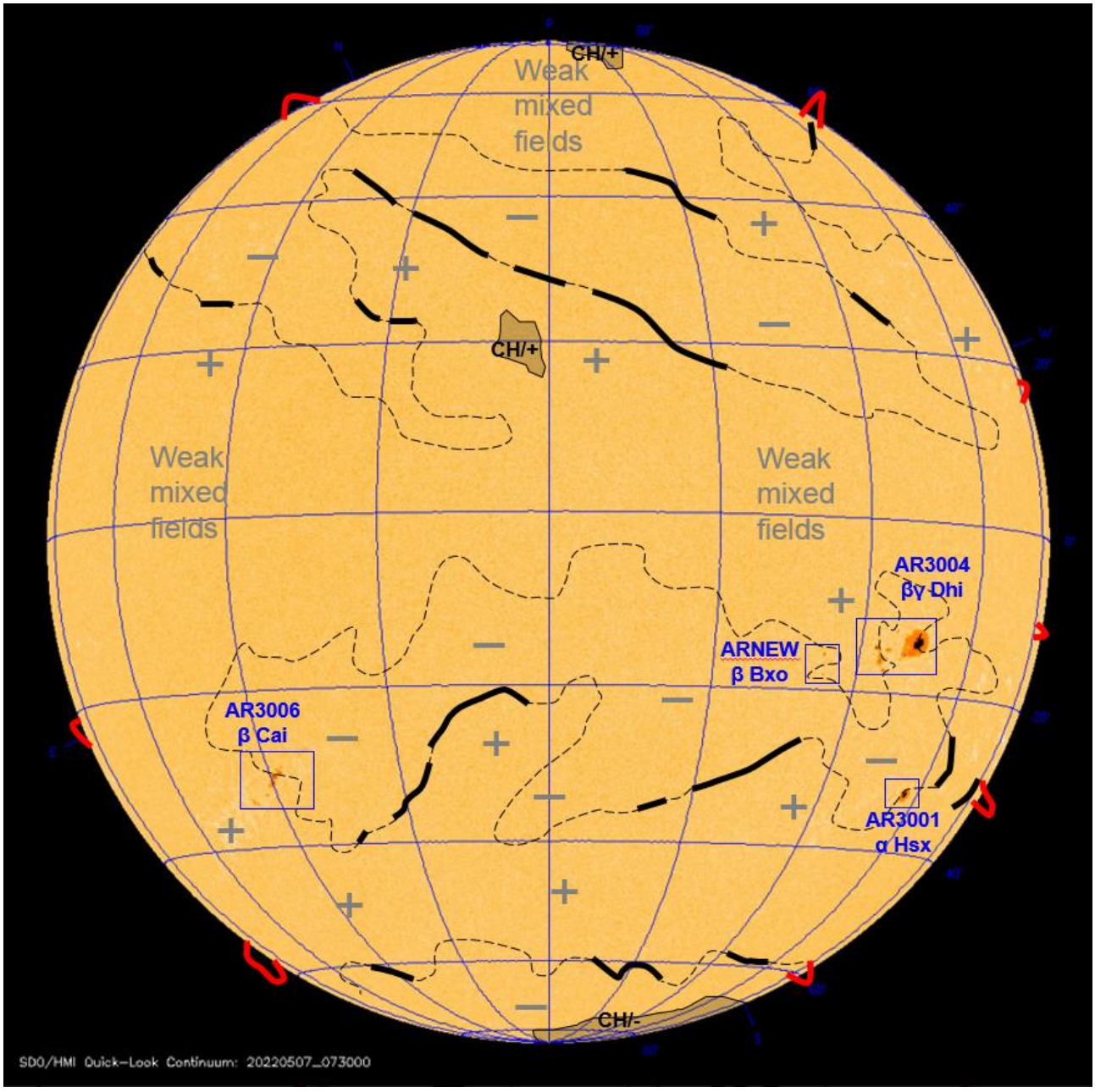
Thereafter a decline in the flux is expected, especially if geomagnetic activity increases with a CME arrival. Therefore the fluence is likely to remain below the Active threshold.

Figure 1. Solar Analysis Valid 0800UTC, 7 May 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

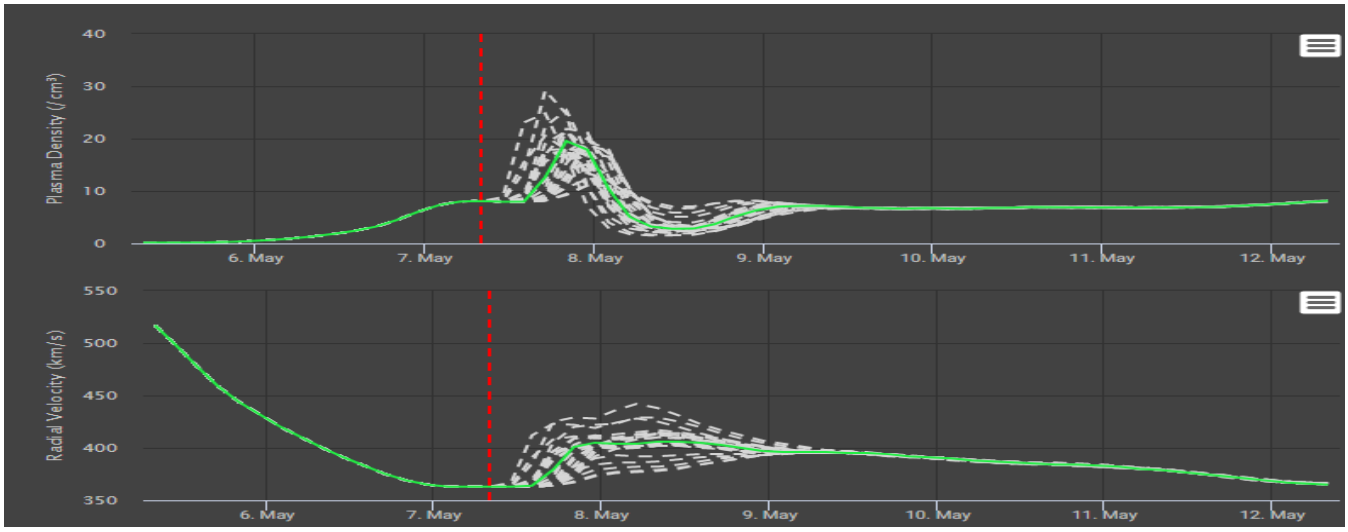
No significant coronal holes feature in this forecast period, and the only potential disruption to an otherwise slow solar wind regime and Quiet outlook is a low confidence CME arrival. The CME stems from a re-analysis of a centre-disc dimming (e.g. in AIA171) in the vicinity of AR3004 on 03 May at 1700UTC. Resulting coronagraph imagery was patchy, but the bulk of the ejecta appears to be angled above and behind the Earth in the track of its orbit. Despite this, there appears to be a likely Earth-bound component, not least because of its central emission location. Met Office Enlil model output puts arrival of this CME late today, with effects probably ongoing into tomorrow before declining to Quiet once again. Confidence is low, due to the diffuse nature of the ejecta, the slow speed of transit and the lack of an obvious accompanying flare on emission. Therefore only a slight chance of a Minor Storm/G1 is given all.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	20	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
04/0552 UTC	Partial	Vicinity of AR3004	NE Quadrant	407 km/s	Late 7th / early 8th May	Low confidence.

Figure 2: Met Office ENLIL ensemble output showing range of arrival times for the CME.



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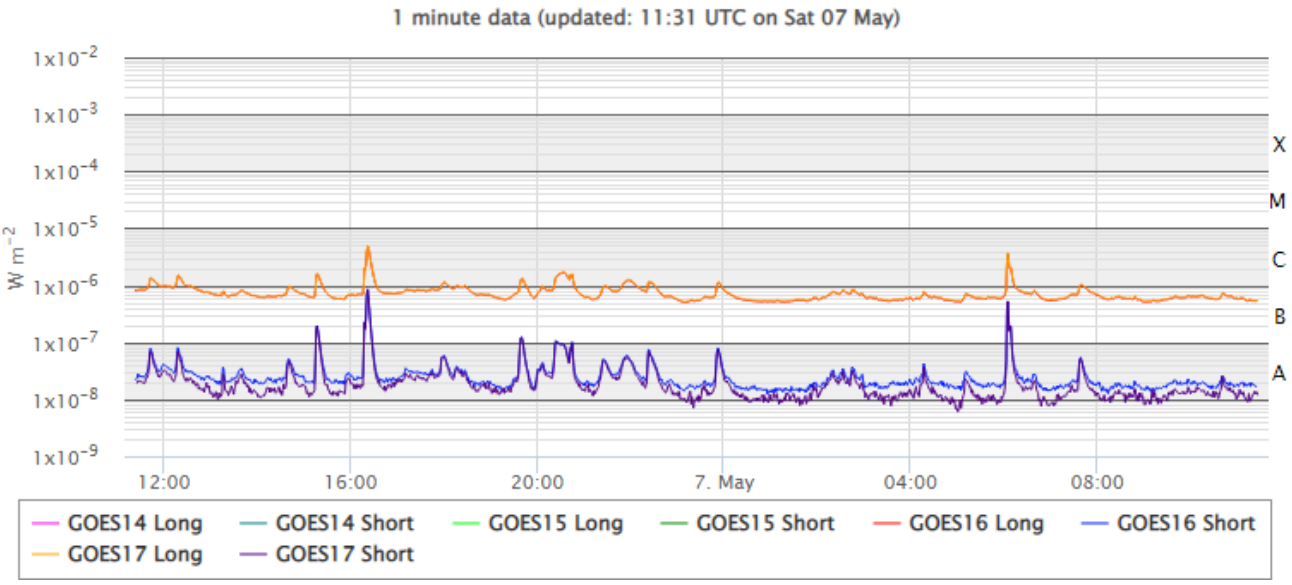
Radio Blackouts - X-Ray Flares:

There are currently three numbered sunspot regions on the visible disc.AR3004 classified as Dhi/beta-gamma with a C4 flare at 06/1622 UTC. AR3006 (Cai/beta) is relatively unchanged with minor activity observed in the leading spots. AR3001 remains a Hsx/alpha. Numerous filaments remain on the visible disc. The C-class flares were produced mainly by AR3004 and as this rotates off the visible disc during the forecast period, the probabilities of significant flares reduces for days 3 and 4 (9 and 10 May. However a potentially significant region may rotate onto the southeast limb this weekend, leading to the chance of increased x-ray activity towards the end of the forecast period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	40	40	20	20
Very Active	R3 to R5 X Class	No	5	5	2	5

Figure 3: GOES X-ray flux plot with several C-class flares in evidence.



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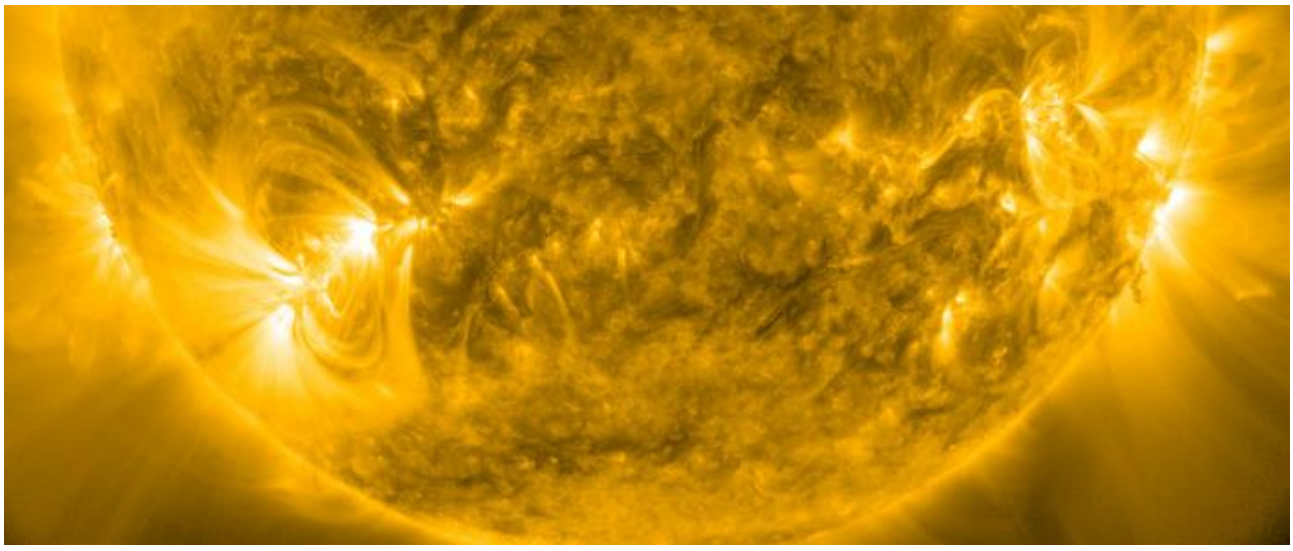
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at Background levels, and is most likely to remain so through the next four days.
There is a daily Slight Chance of S1 or above, largely as a result of AR3004's approach towards the western limb over the forecast period, although it does not have a history of producing any proton response at GOES16, despite a history of M-class flares.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO aia-171 imagery displaying the active regions currently visible across the southern hemisphere.



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High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2MeV) is forecast to be Moderate perhaps reaching High levels in its diurnal oscillation on day 1 (7 May), with a gradual decline in fluence activity levels through the period in the unsupportive current solar wind environment. The likelihood for Active fluence (1e8 integrated flux) levels to be reached probably reducing with time, especially with potential significant geomagnetic activity occurring in the wake of any CME late today and into tomorrow. Output from the Met Office REFM is therefore considered to be offering good guidance in keeping the fluence below the Active threshold, combined with a declining trend.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	30	10	5	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: High energy electon flux at GEO and the Met Office REFM output.

NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours

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